

Fetal Assessment Models

Maternal-Fetal Medicine

Methodist Women's Hospital and Perinatal Center

What Are We Going To Do Today?

- Background and basis for fetal assessment models
- Types of tests
- Who and why to test
- When to test
- Which test to use
- Which is best
- Summary points

Goal of Antepartum Fetal Surveillance?

Goal of Antepartum Fetal Surveillance?

Prevent Stillbirth

The Perfect Surveillance Screen

- Identify the fetus that is at risk for stillbirth due to either suboptimal oxygenation or acidemia
- Low false positive test to avoid iatrogenic morbidity/mortality

Background

- Hypoxemia and/or acidemia may result in alterations in:
 - Fetal heart rate (FHR) pattern
 - Level of fetal activity
 - Degree of muscular tone

Background

- Manning, FA et al. “Fetal Biophysical Profile Score. VI. Correlation with Antepartum Umbilical Venous Fetal pH.” *AJOG*. 169.4 (1993): 755–763.
 - Fetal surveillance prior to cordocentesis
 - Abnormal test, mean pH 7.28
 - Cessation of fetal movement, mean pH 7.16
 - **CANNOT** infer
 - Severity of acid-base disturbance
 - Duration of acid-base disturbance

Limitations to fetal testing

- Cannot account for:
 - Prematurity
 - Fetal sleep-wake cycle
 - Medication exposure
 - Maternal tobacco
 - Fetal CNS abnormalities
 - Acute event (eg trauma, abruption)

Antepartum Fetal Surveillance Techniques

- Fetal movement assessment (Kick Counts)
- Nonstress test (NST)
- Contraction stress test (CST)
- Biophysical profile (BPP)
- Modified BPP
- Doppler velocimetry

Fetal Movement Assessment (Kick counts)

- What is your protocol?

Fetal Movement Assessment (Kick counts) Protocol

- “10 movements in 2 hours”
- Count movements for 1hr Three times weekly
 - If not reassuring, further testing recommended

Fetal Movement Assessment

- Bellussi F, Po' G, Livi A, Saccone G, De Vivo V, Oliver EA, Berghella V. Fetal Movement Counting and Perinatal Mortality: A Systematic Review and Meta-analysis. *Obstet Gynecol.* 2020 Feb;135(2):453-462
 - Meta-analysis of 5 RCTs
 - 450,000 fetuses
 - Perinatal death
 - Kick count group: 0.59%
 - No Kick count group: 0.54%
 - Kick count group: Higher PTB, IOL, cesarean

Fetal Movement Assessment

- Benefits

- Costs nothing

- Risks

- Iatrogenic intervention
- Not associated with perinatal death

Nonstress Test (NST)

- Premise

- FHR of non-acidotic or neurologically depressed fetus temporarily accelerates with fetal movement, uterine contractions, or in response to external stimuli
- Heart rate reactivity is good indicator of normal fetal autonomic function, loss of reactivity most likely sleep cycle

NST results

- Reactive
- Non-reactive

NST result definitions

- Reactive
- Non-reactive

NST result definitions

- Reactive
 - Two accelerations in 20 minutes
 - Acceleration in FHR of 15 beats above baseline for 15 seconds if >32 weeks or 10 beats above baseline for 10 seconds if <32 weeks
- Non-reactive
 - None of the above over 40-minute period

NST Limitations

- Prematurity
 - 24-28 weeks- 50% nonreactive
 - 28-32 weeks- 15% nonreactive
- Variable decelerations
 - 50% NSTs
 - Recurrent, prolonged decelerations warrant prolonged monitoring

Contraction Stress Test (CST)

- Premise
 - Fetal oxygenation will be transiently worsened by uterine contractions
 - Suboptimally oxygenated fetuses □ late decels
 - Well oxygenated fetus □ no decels

Contraction Stress Test (CST)

- Technique

- Lateral recumbent position
- External fetal monitor and tocometer
- 3 contractions lasting at least 40 seconds in 10 minutes
- Contractions can be spontaneous or induced

CST Interpretation

- Negative
 - No late or significant variable decelerations
- Positive
 - Late decelerations associated with $\geq 50\%$ of uterine contractions (UC)
- Equivocal-suspicious
 - Intermittent late decelerations or significant variable decelerations
- Equivocal
 - FHR decelerations occurring in presence of contractions, more frequent than every 2 minutes or lasting longer than 90 seconds
- Unsatisfactory
 - <3 contractions in 10 minutes or uninterpretable tracing

CST Limitations

- 30-40% equivocal

Biophysical Profile Test (BPP)

- Premise
 - Evaluate acute and chronic markers of placental insufficiency

BPP components

- NST
- Fetal breathing (≥ 30 sec / 30 min)
- Fetal movements (≥ 3 body or limb movements / 30 min)
- Fetal tone (≥ 1 episode of extension/flexion of fetal extremity or hand)
- Amniotic fluid volume (AFV) (amniotic fluid index > 5 or single 2 cm vertical pocket)

BPP scoring

- 8-10 Reassuring
- 6 Equivocal
- 4 Usually indicates delivery warranted
- < 4 Expeditious delivery

BPP scoring directly correlates with pH

- 8-10 pH >7.35
- 6 pH >7.3
- 4 pH >7.25
- < 4 pH <7.2

BPP scoring directly correlates stillbirth risk within 7 days

- 8-10 0.8/1000
- 6 89/1000 (oligo), repeat if normal fluid
- 4 91/1000
- < 4 125/1000

Modified BPP

- Acute & chronic evaluation of fetus
 - Acute = NST
 - Chronic = AFV

Modified BPP

- As reliable as full component BPP
 - Stillbirth risk within 7 days is 0.8/1000
- 10% may need full BPP

Doppler Velocimetry

- Non-invasive technique to assess the hemodynamic components of vascular impedance
- Umbilical artery Doppler velocimetry
- Middle cerebral artery Doppler velocimetry

Umbilical Artery Doppler Velocimetry

- Only indication is suspected fetal growth restriction (FGR)
- Appropriately grown for gestational age fetus
 - High-velocity diastolic flow
- FGR fetus
 - Decreased velocity diastolic flow

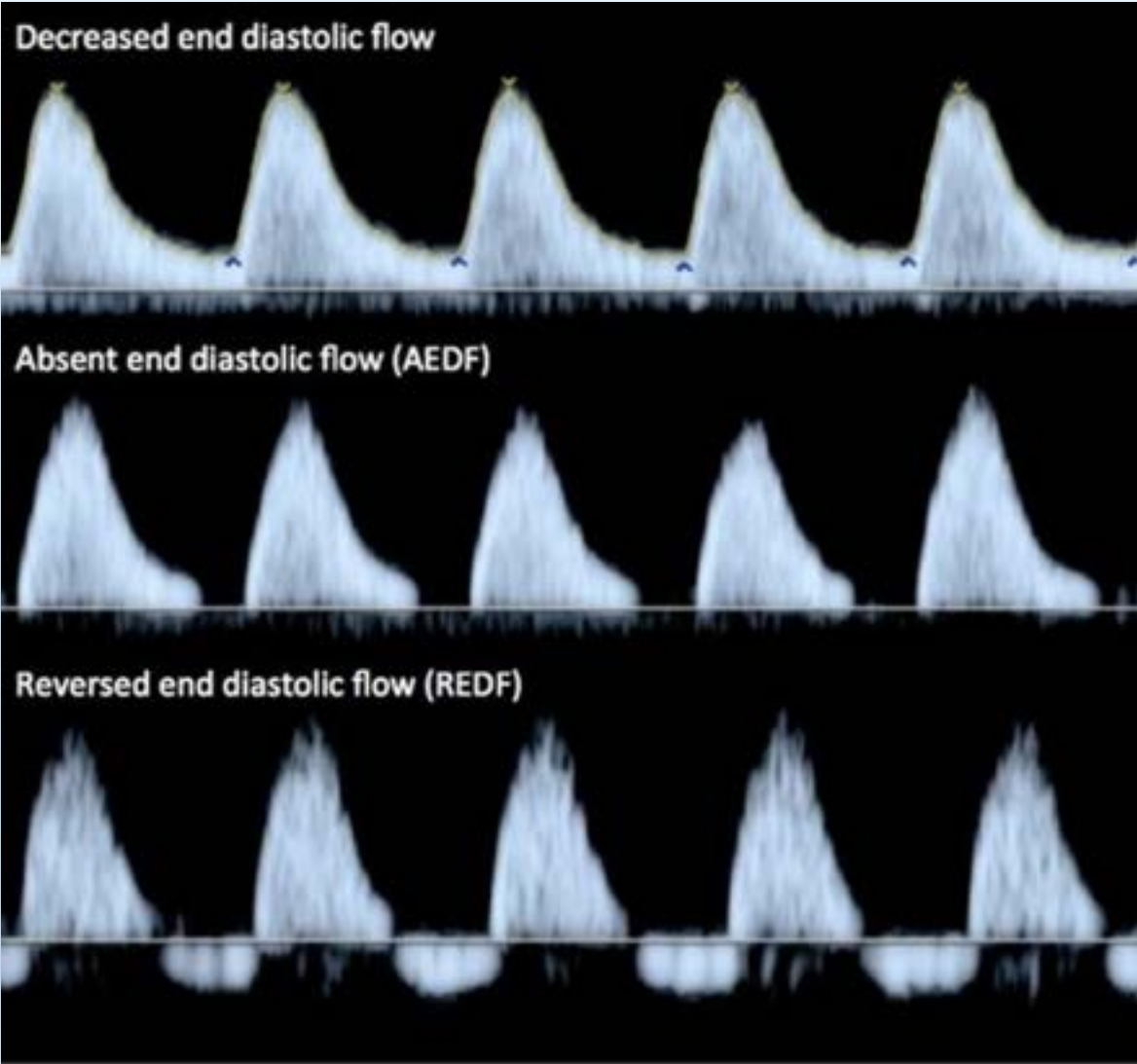
Abnormal Umbilical Artery Doppler

- Absent end diastolic flow (AEDF)
- Reversed end diastolic flow (REDF)
- Elevated S/D ratio > 95%ile for gestational age

Commonly Measured Flow Indices

- S/D ratio (systolic to diastolic ratio)
- Resistance index (S-D/S)
- Pulsatility index (S-D/A)

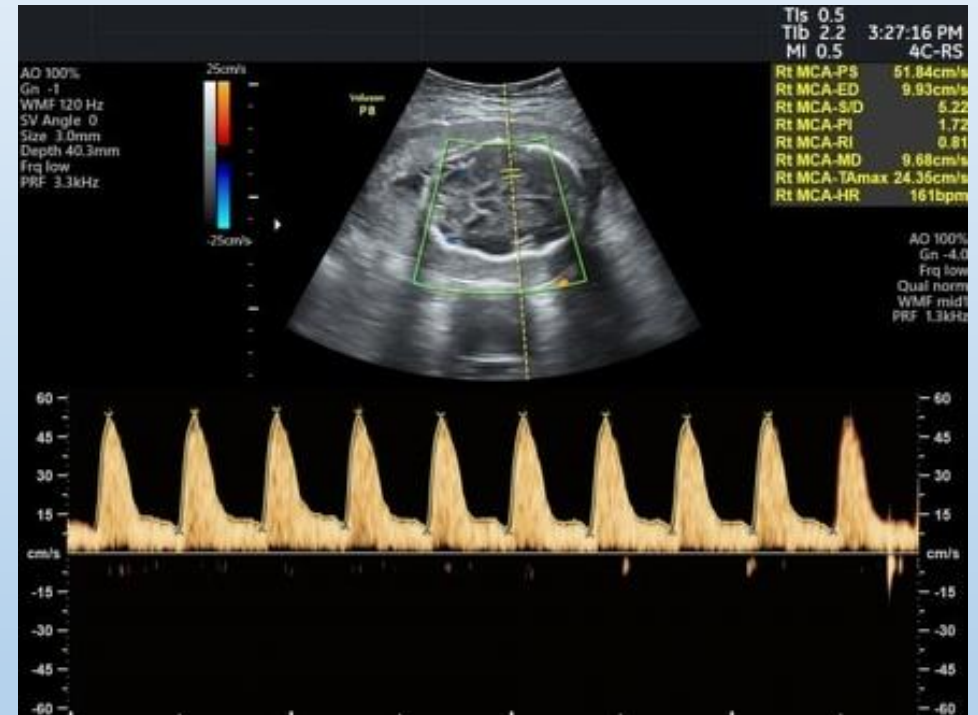
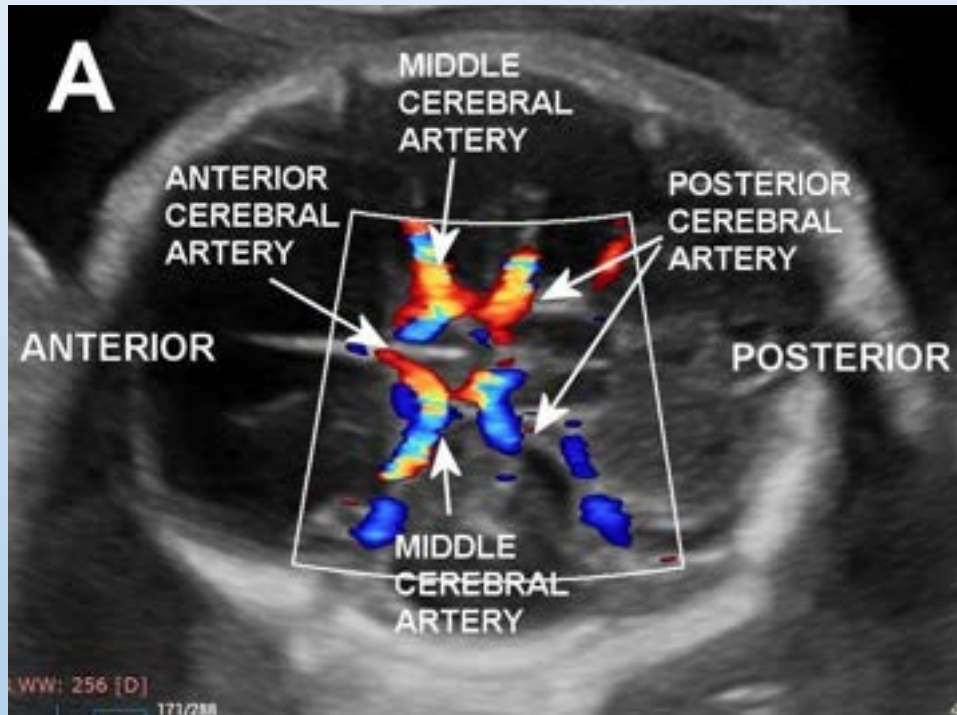
Umbilical Artery Doppler Velocimetry



Middle Cerebral Artery Doppler Velocimetry

- Assess for fetal anemia
- Assess for fetal compensation of placental insufficiency (brain sparing, CPR)

Middle Cerebral Artery Doppler Velocimetry



Indications for Antepartum Fetal Surveillance

Table 1 Factors Associated With an Increased Risk of Stillbirth and Suggested Strategies for Antenatal Fetal Surveillance After Viability

The guidance offered in this table should be construed only as suggestions, not mandates. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised.

Factor	Suggested Gestational Age to Begin Antenatal Fetal Surveillance	Suggested Frequency of Antenatal Fetal Surveillance
Fetal		
Growth restriction ¹		
UAD: normal or with elevated impedance to flow in umbilical artery with diastolic flow present; with normal AFI and no other concurrent maternal or fetal conditions	At diagnosis ²	Once or twice weekly
UAD: AEDV or concurrent conditions (oligohydramnios, maternal comorbidity [eg, preeclampsia, chronic hypertension])	At diagnosis ²	Twice weekly ³ or consider inpatient management
UAD: REDV	At diagnosis ²	Inpatient management ³
Multiple gestation		
Twins, uncomplicated dichorionic	36 0/7 weeks	Weekly
Twins, dichorionic, complicated by maternal or fetal disorders, such as fetal growth restriction	At diagnosis ²	Individualized
Twins, uncomplicated monochorionic-diamniotic	32 0/7 weeks ⁴	Weekly
Twins, complicated monochorionic-diamniotic (ie, TTTS)	Individualized	Individualized
Twins, monoamniotic	Individualized	Individualized
Triplets and higher order multiples	Individualized	Individualized
Decreased fetal movement	At diagnosis ²	Once ⁵
Fetal anomalies and aneuploidy	Individualized	Individualized

Indications for Antepartum Fetal Surveillance

Maternal		
Hypertension, chronic		
Controlled with medications	32 0/7 weeks	Weekly
Poorly controlled or with associated medical conditions	At diagnosis ²	Individualized
Gestational hypertension/preeclampsia		
Without severe features	At diagnosis ^{2,3}	Twice weekly
With severe features	At diagnosis ^{2,3}	Daily
Diabetes		
Gestational, controlled on medications without other comorbidities	32 0/7 weeks	Once or twice weekly
Gestational, poorly controlled	32 0/7 weeks	Twice weekly
Pregestational	32 0/7 weeks ⁸	Twice weekly
Systemic lupus erythematosus		
Uncomplicated	By 32 0/7 weeks	Weekly
Complicated ⁷	At diagnosis ²	Individualized
Antiphospholipid syndrome	By 32 0/7 weeks ⁸	Twice weekly
Sickle cell disease		
Uncomplicated	32 0/7 weeks	Once or twice weekly
Complicated ⁹	At diagnosis ²	Individualized
Hemoglobinopathies other than Hb SS disease	Individualized	Individualized
Renal disease (Cr greater than 1.4 mg/dL)	32 0/7 weeks	Once or twice weekly
Thyroid disorders, poorly controlled	Individualized	Individualized
In vitro fertilization	36 0/7 weeks	Weekly
Substance use		
Alcohol, 5 or more drinks per week	36 0/7 weeks	Weekly
Polysubstance use	Individualize	Individualized

Indications for Antepartum Fetal Surveillance

Prepregnancy BMI		
Prepregnancy BMI 35.0–39.9 kg/m ²	37 0/7 weeks	Weekly
Prepregnancy BMI 40 kg/m ² or above	34 0/7 weeks	Weekly
Maternal age older than 35 years	Individualized ¹⁰	Individualized
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Obstetric		
Previous stillbirth		
At or after 32 0/7 weeks	32 0/7 weeks ¹¹	Once or twice weekly
Before 32 0/7 weeks of gestation	Individualized	Individualized
History of other adverse pregnancy outcomes in immediately		

When Should Antepartum Fetal Surveillance Begin?

- Prognosis for neonatal survival?
- Severity of maternal disease?
- Risk of fetal death?
- **Potential for iatrogenic morbidity?**
- **Will we intervene?**

What Is The Proper Frequency Of Testing?

Any significant change in either maternal or fetal condition requires reevaluation, regardless of the amount of time that has elapsed since the last test

Which Test To Use?

In most clinical situations, no single antepartum fetal test can be considered superior to any other

What Do You Do?

Mode Of Delivery

- Positive CST = C/S
- BPP < 4 = C/S
- Otherwise, individualize
 - Trial of labor is usually not contraindicated

Summary Points

- Those with an increased risk for IUFD should undergo antepartum fetal surveillance
- Normal tests are very reassuring
- Abnormal tests need to be further evaluated in a cascade or sequential manner
- Any change in condition requires reevaluation, regardless of when last done

Summary Points (continued)

- Umbilical artery Doppler velocimetry has only been shown to be beneficial in suspected FGR
- Middle cerebral Doppler velocimetry is only investigational (or in MFM office)
- Antepartum fetal surveillance will not predict acute catastrophic events
- The perfect surveillance modality does not exist